example, physical vapor deposition methods such as sputtering and electron beam evaporation, and plasma assisted methods such as plasma chemical vapor deposition, can be used to practice the present invention. In some cases it might be necessary with such coating methods to coat one set of surfaces of the substrate in one procedure, then rotate the substrate in a tooling fixture in order to allow deposition of the desired coating on the remaining surface(s) of the substrate. Any method which can be used to deposit a durable, well defined optical coating may be used to practice the current invention, provided that the method is capable of applying the thin film optical coating over at least 90% of the total surface of the substrate.

The present invention may be further understood by reference to the following examples.

EXAMPLE 1

A substrate composed of cubic zirconium dioxide and formed with cut and polished facets as in FIG. 1 was placed in a chamber and the chamber sealed. The atmosphere was exhausted from the chamber by means of a vacuum pump, and the chamber and substrate heated by external heaters to a temperature of about 500° C. Organometallic precursors capable of decomposing at 500° C. to give thin films of silicon dioxide and tantalum pentoxide are alternately admitted to the chamber, each precursor being admitted in turn for a length of time sufficient to deposit the coating described by the following graphic representation of the coating: Substrate $(HL)^4$ H ½L, where each H corresponds to a layer composed of tantalum pentoxide with a nominal thickness of 471 Ångstroms, and L corresponds to a layer composed of silicon dioxide with a nominal thickness of 715 Ångstroms.

When the deposition of the optical coating was complete, the chamber was cooled, air admitted, and the coated substrate removed. Visual examination showed that the coated substrate had a visual color of golden orange in transmission and blue in reflection. The perceived color was dependent on the angle of incidence of the illumination and the relative positions of the object and the viewer. A reflectance scan of a flat glass which was coated using the same procedure is shown in FIG. 3.

EXAMPLE 2

A substrate composed of lead crystal glass and formed in the shape of a turtle was placed in a chamber and the chamber sealed. The atmosphere was exhausted from the chamber by means of a vacuum pump, and the chamber and substrate heated by external heaters to a temperature of about 500° C. Organometallic precursors capable of decomposing at 500° C. to give thin films of silicon dioxide and tantalum pentoxide are alternately admitted to the chamber, each precursor being admitted in turn for a length of time sufficient to deposit the coating described by the following graphic representation of the coating: Substrate $(HL)^4$ H ½L $(1.7H\ 1.7L)^4$ 1.7H 0.8L, where each H corresponds to a layer composed of tantalum pentoxide with a nominal thickness of 471 Ångstroms, and L corresponds to a layer composed of silicon dioxide with a nominal thickness of 632 Ångstroms. These layer thicknesses were chosen so as to provide a coating that would reflect the blue and red portions of the visible spectrum and transmit the green portion of the visible spectrum.

When the deposition of the optical coating was complete, the chamber was cooled, air admitted, and the coated substrate removed. Visual examination showed that the object produced had a visual color of green in transmission and silvery pink in reflection. The perceived color was dependent on the angle of incidence of the illumination and the relative positions of the object and the viewer. A reflectance scan of a flat glass which was coated using the same procedure is shown in FIG. 4.

It is apparent from the foregoing discussion and examples that the present invention has provided a novel article of manufacture that is of great utility as a synthetic gemstone or decorative object.

What is claimed is:

1. An article of manufacture comprising a substantially transparent substrate of a size and shape suitable for use as a decorative object gemstones and ornaments and a multilayer thin film interference coating over substantially the entire surface of said substrate, said coating consisting of alternating layers of substantially nonabsorbing materials with a relatively high refractive index and a relatively low refractive index with respect to each other, the thicknesses and identities of said layers being chosen so that the entire coating will preferentially reflect at least some of the incident light with wavelengths between 400 nanometers and 700 nanometers inclusive.

2. The article in claim 1 in which the substrate is a member selected from the group consisting of silicon dioxide, aluminum oxide, zirconium oxide, titanium oxide, hafnium oxide, germanium oxide, zinc oxide, scandium oxide, yttrium oxide, calcium oxide, magnesium oxide, barium oxide, beryllium oxide, boron oxide, phosphorus oxide, lead oxide, arsenic oxide, sodium oxide, potassium oxide and carbon.

3. The article in claim 1 in which the substrate is comprised of a polymeric material.

4. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are composed of metal oxides.

5. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating comprise materials selected from the group consisting of silicon dioxide, aluminum oxide, tantalum oxide, niobium oxide, titanium dioxide, hafnium dioxide, zirconium dioxide, magnesium fluoride, calcium fluoride, zinc sulfide, zinc selenide and carbon.

6. The article of claim 1 in which the number of layers comprising the multilayer thin film interference coating is three or greater.

7. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by a chemical vapor deposition process.

8. The article claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by a low pressure chemical vapor deposition process.

9. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by plasma assisted process.

10. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by a sputtering process.

11. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by an evaporative coating process.

12. The article of claim 1 in which the alternating layers comprising the multilayer thin film interference coating are sequentially deposited by spraying onto the surface of the substrate liquid solution containing materials capable of being decomposed to form the desired layers.

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13. An article of manufacture comprising a substantially transparent substrate having at least one curved surface and a multilayer thin film interference coating over substantially the entire surface of said substrate, said coating consisting of alternating layers of substantially nonabsorbing materials with a relatively high refractive index and a relatively low refractive index with respect to each other, the thicknesses and identities of said layers being chosen so that the entire coating will preferentially reflect and transmit at least some of the incident light within predetermined wavelength bands.

14. The article of Claim 13 wherein the entire coating preferentially transmits at least some of the incident light above a predetermined wavelength.

15. The article of Claim 13 wherein the entire coating preferentially transmits at least some of the incident light below a predetermined wavelength.

16. The article of Claim 13 having a size and shape suitable for use as a decorative object selected from the group consisting of gemstones and ornaments.

17. An article of manufacture comprising:

a non-planar substrate formed from a substantially transparent material; and

a substantially uniform multilayer thin film interference coating over substantially the entire surface of said non-planar substrate, said coating comprising alternating layers of materials having different refractive indices to thereby form a coating which is substantially transmissive of incident light at predetermined wavelengths.

18. The article of Claim 17 wherein the coating is substantially transmissive of incident light above a predetermined wavelength.

19. The article of Claim 17 wherein the coating is substantially transmissive of incident light below a predetermined wavelength.

20. The article of Claim 17 wherein the coating is substantially transmissive of incident light within a predetermined wavelength band.

21. The article of Claim 17 having a size and shape suitable for use as a decorative object selected from the group consisting of gemstones and ornaments.

22. A uniformly coated complex shaped object comprising a complex shaped substrate formed from a substantially transparent material and a coating over substantially the entire surface thereof, said coating comprising alternating layers of materials having relatively high and relatively low reflective indices relative to each other and being substantially uniform and over substantially the entire surface of said substrate.

23. The object of Claim 22 wherein said coating controls the transmission of incident light at predetermined wavelengths.

24. The object of Claim 22 wherein said coating controls the absorption of incident light at predetermined wavelengths.

25. The object of Claim 22 wherein said coating controls the reflection of incident light at predetermined wavelengths.

26. The article of Claim 22 having a size and shape suitable for use as a decorative object selected from the group consisting of gemstones and ornaments.

27. A decorative object comprising a substantially transparent substrate and a coating uniformly covering substantially the entire surface of the substrate, said coating comprising alternating layers of materials having differing refractive indices to thereby substantially transmit all of the incident light at predetermined wavelengths.

28. An article of manufacture comprising a substantially transparent substrate having two or more planar surfaces and a coating uniformly covering substantially the entire surface of the substrate, said coating comprising alternating layers of materials having differing refractive indices to thereby substantially transmit all of the incident light at predetermined wavelengths.

29. A method of making a uniformly coated object having a complex shape, said method comprising the steps of:

(a) providing a substrate having a complex shape;

(b) depositing a coating over substantially the entire surface of the complex shaped substrate, the coating comprising alternating layers of materials having different indices of refraction so that the coating is substantially transmissive of light at predetermined wavelengths.

30. The method of Claim 29 wherein the coating is deposited by low pressure chemical vapor deposition.

31. The method of Claim 29 wherein the object has a size and shape suitable for use as a decorative object selected from the group consisting of gemstones and ornaments.

32. The method of Claim 29 wherein the coating is substantially transmissive of incident light above a predetermined wavelength.

33. The method of Claim 29 wherein the coating is substantially transmissive of incident light below a predetermined wavelength.

34. The method of Claim 29 wherein the coating is substantially transmissive of incident light within a predetermined wavelength band.

35. A method of making a uniformly coated object having a at least two planar surfaces, said method comprising the steps of:

(a) providing a substrate having at least two planar surfaces;

(b) depositing a coating over substantially the entire surface of the planar shaped substrate, the coating comprising alternating layers of materials having different indices of refraction so that the coating is substantially transmissive of light at predetermined wavelengths.

36. The method of Claim 35 wherein the coating is deposited by low pressure chemical vapor deposition.

37. The method of Claim 35 wherein the coating is substantially transmissive of incident light above a predetermined wavelength.

38. The method of Claim 35 wherein the coating is substantially transmissive of incident light below a predetermined wavelength.

39. The method of Claim 35 wherein the coating is substantially transmissive of incident light within a predetermined wavelength band.